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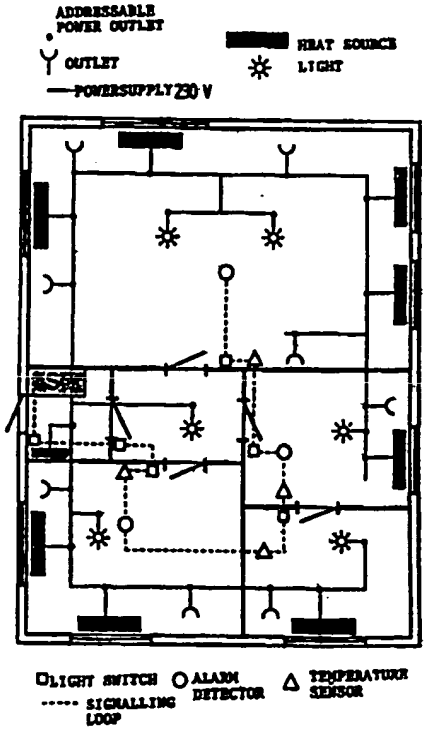
(54) Title: METHOD AND ARRANGEMENT FOR CONTROLLING ELECTRICAL DEVICES

(57) Abstract

A method and device for controlling electrical devices which consist of a number of distributed power outlets that are able to carry out different actions, such as turning lights on and off, regulating heat, triggering fire extinguishing system etc. Further, there are a number of distributed transmitters and a central unit. The power outlets and the transmitters are all given unique addresses, and the central unit provides a description of a logical connection between the transmitters and the power outlets. The activation of a transmitter and/or response from a transmitter to a query from the central unit sends a signal to the central unit, which in turn processes the signal, and on the basis of the logical connection passes on the signal to the power outlets concerned so that they carry out the necessary actions. The control of one or more of the categories of equipment: lights, heating, alarms etc., can be achieved within a single system.



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METHOD AND ARRANGEMENT FOR CONTROLLING ELECTRICAL DEVICES

The invention concerns a procedure for a control system for electrical devices, as described in Claim of Patent 1.

Background to the Invention

There are different systems on the market for controlling light, heat and alarms. These systems have been realized in various ways. Some use low voltage signals on their own signal cables, others send signals via the mains power supply. The switches are often placed centrally in the fuse box, a solution that is both costly and rather inflexible as it leads to a large number of power circuits, also new power cables have to be laid when any changes are made later on. The existing systems are in practice control systems dedicated specifically to either light, heat or alarms.

From US Patent Specification 4 429 299 an alarm or monitoring system is known, with transmitters and receivers that use the mains power supply for signalling. This is based on a room as a unit and is not addressed individually to transmitters or receivers. In the known system mentioned here all signals are sent via the mains power supply, even units that do not require 110/230V power supply. Communication is then done by central polling, which provides a relatively low bandwidth and poor response time. The system will therefore not be suited to e.g. controlling lights.

Objective of the Invention

The main objective of the invention is to arrive at a control system for electrical devices that makes it possible to treat information from individual transmitters for the purpose of being able to control individual power outlets.

A further objective of the invention is to satisfy the requirements on safety and speed of control of light, heat and alarms, so that all these three functions can be integrated in a single system.

Another objective of the invention is to be as flexible as possible with respect to the signalling medium, so that it is possible to use the invention in the best way both for new and old buildings/premises.

A further objective of the invention is to produce a concept that is economical in installation and use, and also during any subsequent alterations and maintenance.

The above objectives are achieved by a procedure in accordance with the present invention, described in the sections characterizing the accompanying Claim of Patent.

Description of Diagrams

Examples of the design of the invention will be given below, with reference to the accompanying diagrams where Figure 1 shows an example of installing the cables in an installation in accordance with the invention.

Figure 2 shows a matrix for logical connection between transmitters and power outlets in accordance with the invention.

Figure 3 shows a design in accordance with the invention, where the transmitter network and the outlet supply are connected via a bridging device in the central unit.

Description of Means of Realizing the Concept

In a preferred design for the invention there are three main components: power outlets, transmitters and one or more central units which join a number of these components together.

The term power outlets means all points in an installation, outside the fuse box, where power can be supplied for one purpose or another. Examples of power outlets in the home are sockets, light fittings, junction boxes for heating cables or heating foil, air_conditioning etc.).

Each power outlet is given a unique address in the system. The setting up of the unique address can for example

be done with dip-switchers, or using another known technique that is already recognized and which is not part of the present invention. If each power outlet is now equipped with electronics in order to recognize its own address and simple commands (ON, OFF etc.) the power outlets will be able to be remote-controlled. This remote control is preferably to be done by signals via the mains power supply (230V), which avoids the necessity of laying a special signal cable. However, it is within the scope of the invention to use a different type of signal to the power outlets, e.g. using a separate supply. The signal supply for the power outlet will hereafter be called the "outlet supply". This name only describes the function and does not relate to how or by which medium the supply is realized.

The switches are built in locally in each power outlet. The term "switch" is not limited to on/off devices, but also to devices with possibilities for control within an interval. Such control may be in steps, continuously or in other well-known ways. As the switches are not placed centrally in the fuse box but distributed around the installation built into the individual power outlets, a suitable way of dividing up the total system into power circuits can be determined solely on the basis of the load represented by each power outlet and where the various outlets are actually situated in relation to one another. How the individual power outlets are to be controlled and which outlets, if any, are to be controlled together, is totally irrelevant to how the circuits are divided up.

Remote control of the individual power outlets through the outlet supply is on the basis of signals given by various transmitters distributed around the installation. Transmitters in this context means units that in one way or another are intended to affect or give information about the state of the system, defined as the state of the total set of controllable power outlets connected with parameters such as outside temperature and in the different rooms, time of day, weekday or weekend etc. A transmitter can be activated

(and a signal then sent to the central unit) either manually (pressing a light switch) or automatically (smoke detector, thermostat etc.). Examples of this type of transmitter are switches and regulators for light and heat, temperature sensors various detectors for alarms and monitoring etc. By including one or more infrared receivers the installation can also be wholly or partially controlled by using remote control, for example by the same type as is used for TVs. This is already known as in German patent DE 3 035 965, for example.

The transmitters are connected in one or a number of circuits, hereafter called the "transmitter network". In new buildings it will probably be most economical to connect the transmitters by a separate low voltage circuit. This can be done in different ways. One example is found in Patent Specification GB 2 123 589, which describes an error-tolerant three-wire connection, two others are Phillips' I^2C and D^2B serial buses. In order to install the system easily in existing configurations, however, the central unit should also be able to use the mains power supply as a transmitter network. This will also be suitable in cases where one transmitter is far away from the others (e.g. a garage light switch), as it will not be necessary to install a special circuit in that direction just for the one transmitter.

Even though the transmitter and outlet supplies are using different cable systems, they both make use of the same signal protocol. This makes it possible for a transmitter to send a signal directly to the power outlet without going via the central unit. If the two supplies have separate cable systems the interface between them will convert the signals as necessary. By using this possibility of having a direct connection between transmitter and power outlets, the system can then be made tolerant of errors in the central unit.

As will be described later, the logical connection between transmitters and power outlets is defined by a connection matrix in the central unit. In addition, however,

each transmitter is installed with its standard power outlet(s). This is defined in the transmitter electronics, using dip-switchers, program parameters, or using another known technique. A transmitter of the light switch type can for example have a standard connection for a certain lamp point with a given address; a transmitter of the thermostat type can be connected to one or more power outlets for panel heaters with different addresses, and so on.

Each time a transmitter is activated at least two signals are always sent on the transmitter network, hereafter numbered

1-n: Signal no. 1 is addressed to the central unit, Signals 2-n directly to the relevant standard power outlet. The interface between the transmitter and outlet supplies contains a bridging device. This device functions as a signal filter, controlled by a watchdog system in the central unit:

As long as the central unit is functioning, the bridging device will route Signal no. 1, addressed to the central unit, to the central unit. The central unit receives the signal, decodes it with assistance from the connection matrix and then sends one (or more) commands out to the power outlet(s) involved via the outlet supply. Signals 2-n, addressed directly to the relevant standard power outlets are removed by the bridging device and never reach the power outlets they are addressed to.

If the central unit ceases to function for any reason, this will be detected by the bridging device because the watchdog signal will be missing. The bridging device then disconnects the central unit (Signal no. 1 addressed to the central unit is removed) and establishes direct contact between the transmitter and the standard power outlet. Signals 2-n (addressed to the relevant standard power outlets) are then sent on, with the signals converted where necessary, to the outlet supply and the power outlets that are addressed. The transmitter now signals in principle to its standard power outlet(s) directly. This is illustrated in Figure 3.

In the same way as the power outlets, each transmitter will have a unique address. When a transmitter is activated (manually or automatically) it will send two or more signals to the transmitter network, the first signal addressed to the central unit, the subsequent ones addressed to the transmitter's standard power outlet. The signal to the central unit consists of the transmitter's address and the reason that it has been activated (pressure on light switch, smoke detected etc.). The signal(s) to standard power outlets consists of commands to them (ON, OFF etc.). The signals can also include data to facilitate and ensure communication (possibility for error detection, check sum).

When the central unit receives a signal from a transmitter, the central unit will take action. The connection between signal (influence) and action (response) can be illustrated by a "connection matrix". An example of a model of this type of matrix is shown in Fig. 2. The connection matrix contains a complete description of the connection between the individual transmitters and power outlets. This connection can either be given solely by the signal received (contain the transmitter's address, reason for activation, etc.) or it can also be a function of (parts of) the total state of the system at that moment, perhaps also including the situation leading up to the present state. The state of the system covers parameters such as which power outlets are connected, outside temperature and temperature in the different rooms, time of day, weekday or weekend, etc. On the basis of this information a decision is then made as to what action is to be taken when the signal is received. There is also a possibility that nothing is to happen as a response to some signals, but that the signals are to be recorded and produce a response later, e.g. combined with other signals by a logical AND-function or similar. All parameters of state are of course not relevant for every combination of transmitters and power outlets (the operation of the light-switches, for example, will hardly be a function of the temperature). The actual invention, however, does not place any limitation on the connection

between transmitters, power outlets and parameters of state; this is decided solely by the way one wants the system to function.

Note that Fig. 2 is meant to give an example of how it is possible to build up this kind of connection matrix, it does not indicate the way this is done in practice.

Action/response in this context means on/off connection or regulation of one or more power outlets. In contrast with the installation systems of today, where the transmitters (e.g. the light switches) are physically connected to one or more power outlets (light fittings), the invention provides a straightforward logical connection between the transmitter and power outlets via the program in the central unit.

Compared with the installation systems of today, the invention has a number of advantages for those who produce and install it as well as for the owner of a building:

- Economy. The concept is modular, together with the advantage of integration and considerable reduction of the necessary laying of cables, this provides a system that will be cost-effective in homes and offices, institutions and business premises.
- New/old premises. The system can be installed both in new and old premises.
- Flexibility. The transmitters are placed where they ought to be for the convenience and comfort of the user, regardless of where the power outlets are situated. Changes in the connections between transmitters and power outlet(s) are made simply in the central unit.
- New functions. There are many possibilities, for example: grouped lighting - light fittings, e.g. decorative lamps, are controlled by the same switch.
- night lighting - when going to bed for the night, a light switch by the bed is used to turn off the lights that are to be turned off and switch on all those that are to be lit.
- when away - the automatic system ensures that lights are turned on and off in a natural way when there is nobody at home.

- Remote control. The system can be remote-controlled in a simple way, e.g. by using an infrared remote_control like that used for TVs if a receiver for infrared signalling is incorporated in the transmitter network.

- Energy control. By connecting all the electrical heat sources via power outlets that can be addressed, these can be controlled for time (day and night reduction) and temperature from the central unit. The temperature is read, using temperature transmitters attached to the transmitter network; alternatively the temperature can be controlled by using a local thermostat placed near the individual heat source. A simple additional option is one that overrides the system locally (it can be switched on again automatically after a certain time).

- High degree of integration provides new possibilities. Some examples of this:

the same temperature sensors are used by the alarm functions and the heat control.

if no switches are touched for a certain time, e.g. 24 hours, this can be an indication that something is wrong (safety alarm for the elderly).

CLAIM OF PATENT:

1. A method of controlling electrical systems which include a number of distributed power outlets that are able to carry out different actions, such as turning lights on and off, regulating heat, triggering fire extinguishing systems etc., a number of distributed transmitters and a central unit, c h a r a c t e r i z e d by the power outlets being given unique addresses, and by the central unit giving a description of a logical connection between the transmitters and the power outlets, so that activation of a transmitter and/or response from a transmitter to a query from the central unit provides a signal to the central unit, which in turn processes the signal, and on the basis of the logical connection passes on the signal to the power outlets concerned to carry out the necessary actions, and that control of one or more of the categories of equipment lights, heating, alarms etc., can be achieved within a single system.

2. Method in accordance with Claim 1, c h a r a c t e r i z e d by the transmission of signals from the transmitters being carried out on the same physical cable system as the power outlets.

3. Method in accordance with Claim 1, c h a r a c t e r i z e d by the transmission of signals from the transmitters being carried out on a different physical cable systems from the power outlets.

4. Method in accordance with Claims 1-2, c h a r a c t e r i z e d by the central unit being able to combine information from the transmitters with information about the state of the system in other respects (time etc.) for initiating action.

5. Method in accordance with one or more of the above claims, c h a r a c t e r i z e d by the power outlets being controlled as on/off switches, and/or regulators where the voltage can be changed continuously and/or in steps in the interval between completely off and completely on.

6. Method in accordance with one or more of the above claims, c h a r a c t e r i z e d by the transmitters themselves being able to initiate action at their defined standard power outlets if the central unit should cut out.

7. Method in accordance with one or more of the above claims, c h a r a c t e r i z e d by several systems, each controlled by its own central unit, being able to be used together, by direct communication between them and/or by a superior control unit.

8. Arrangement for electrical systems, particularly for homes, offices and similar for carrying out the method in accordance with Claims 1-7, where there is a system of cables to at least one power outlet, and where there are also one or more signal transmitters for the state of switches etc., and/or one or more signal transmitters to provide a signal concerning temperature and similar factors in the room, to a central unit,
c h a r a c t e r i z e d by all the transmitters and power outlets being individually addressable, and that the central unit includes circuits for interrupt-controlled and/or polled signalling to the transmitters, and that this signalling is on a shared signal channel, further there are also circuits in the central unit which enable the signalling to the central unit from transmitters and from the central unit to the power outlets to be done on a separate signal network and/or via the mains power supply.

AMENDED CLAIMS

[received by the International Bureau on 19 June 1990 (19.06.90); original claims 1-8 replaced by amended claims 1-8 (3 pages)]

1. A method for controlling electrical systems which include

a plurality of distributed power outlets, which are able to carry out various actions, such as switching light, regulating heat, trigging fire extinguishing systems, trigging safety alarms, etc.,

a plurality of distributed transducers registrating ambient influences, such as activation of a switch, temperature level, presence of smoke, etc; and

a central unit able to communicate with said plurality of distributed transducers and said plurality of power outlets by means of signals on electrical cables, wherein a first set of signals from said plurality of distributed transducers are communicated to the central unit; and a second set of signals communicated between the central unit and said plurality of distributed power outlets in order to carry out necessary actions,

c h a r a c t e r i z e d by

each of said plurality of distributed power outlets is given a unique adress identifying a specific power outlet;

each of said plurality of distributed transducer is given a unique adress identifying a specific transducer;

said first and said second sets of signals are being communicated directly to and from, respectively, the central unit over a local network using a defined protocol in which a message at least includes the address of a transducer or a power outlet;

said protocol includes a possibility to also communicate digital values other than 0 and 1,

communication between the central unit and said plurality of distributed power outlets are being carried out on the same physical cable system as the power supply; and

the central unit includes a preprogrammed set of data and instructions, permitting the central unit to carry out necessary actions using said preprogrammed set of data and instructions, status of at least one of said plurality of transducers or status of at least one of said plurality of power outlets, or combinations thereof.

2. Method in accordance with Claim 1, c h a r a c t e r i z e d by the transmission of signals from the transducers being carried out on the same physical cable system as the power outlets.

3. Method in accordance with Claim 1, c h a r a c t e r i z e d by the transmission of signals from the transducers being carried out on a different physical cable systems from the power outlets.

4. Method in accordance with Claims 1-2, c h a r a c t e r i z e d by the central unit being able to combine information from the transducers with information about the state of the system in other respects (time etc.) for initiating action.

5. Method in accordance with one or more of the above claims, c h a r a c t e r i z e d by the power outlets being controlled as on/off switches, and/or regulators where the voltage can be changed continuously and/or in steps in the interval between completely off and completely on.

6. Method in accordance with one or more of the above claims, c h a r a c t e r i z e d by the transducers themselves being able to initiate action at their defined standard power outlets if the central unit should fail.

7. Method in accordance with one or more of the above claims, c h a r a c t e r i z e d by several systems, each controlled by its own central unit, being able to be used together, by direct communication between them and/or by a superior control unit.

8. Apparatus for electrical systems, particularly for homes, offices and similar for carrying out the method in accordance with Claims 1-7, including a system of cables to at least one power outlet, and further including one or more signal transducers for the state of switches etc., and/or

one or more signal transducers to provide a signal concerning temperature and similar factors in the room, to a central unit, c h a r a c t e r i z e d by all the transducers and power outlets being individually addressable, and that the central unit includes circuits for interrupt-controlled and/or polled signalling to the transducers, which signalling is being done by means of a local network and a protocol, and at least the signalling between the central unit and the power outlets is being done on the same cables as the mains power supply.

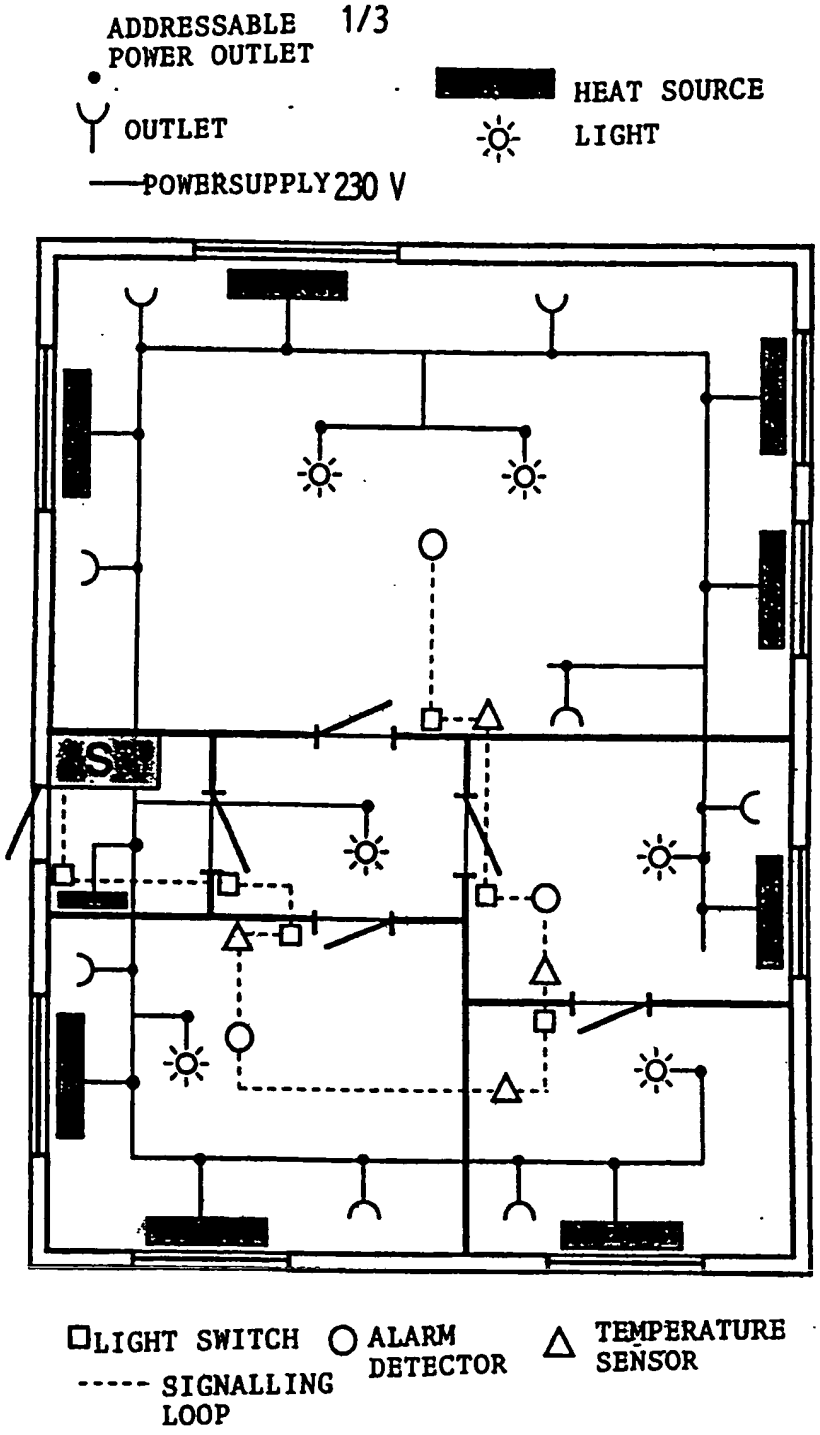

Fig. 1

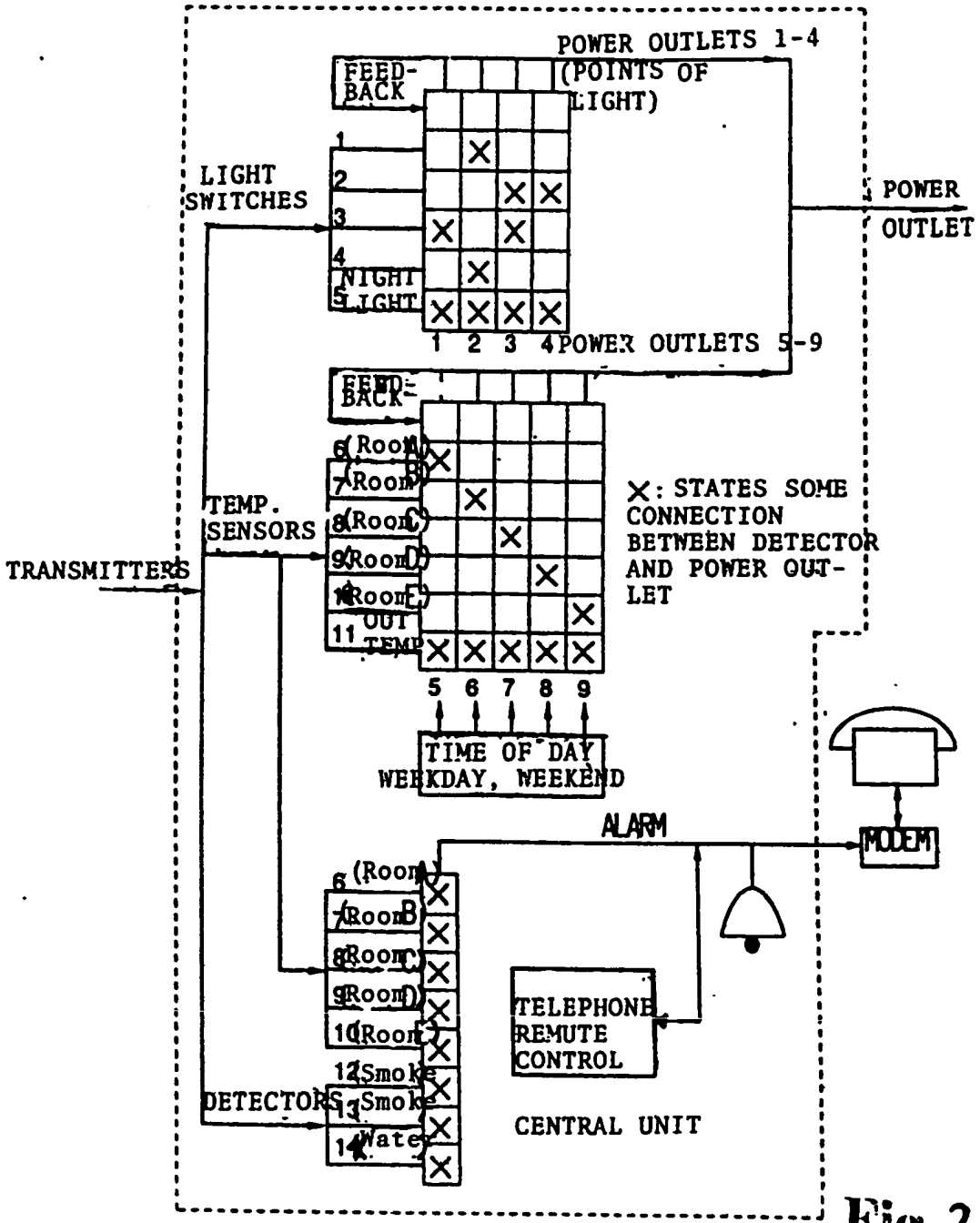
POWER OUTLETS 1-4
(POINTS OF LIGHT)
FEED-BACK
LIGHT SWITCHES
1
2
3
4
NIGHT LIGHT
5
1 2 3 4
POWER OUTLETS 5-9
POWER OUTLET
FEED-BACK
TEMP. SENSORS
TRANSMITTERS
6 (Room A)
7 (Room B)
8 (Room C)
9 (Room D)
10 (Room E)
11 OUT TEMP
X: STATES SOME CONNECTION BETWEEN DETECTOR AND POWER OUT-LET
5 6 7 8 9
TIME OF DAY
WEEKDAY, WEEKEND
ALARM
MODEM
6 (Room A)
7 (Room B)
8 (Room C)
9 (Room D)
10 (Room E)
12 Smoke
13 Smoke
14 Water
DETECTORS
TELEPHONE REMUTE CONTROL
CENTRAL UNIT

Fig.2

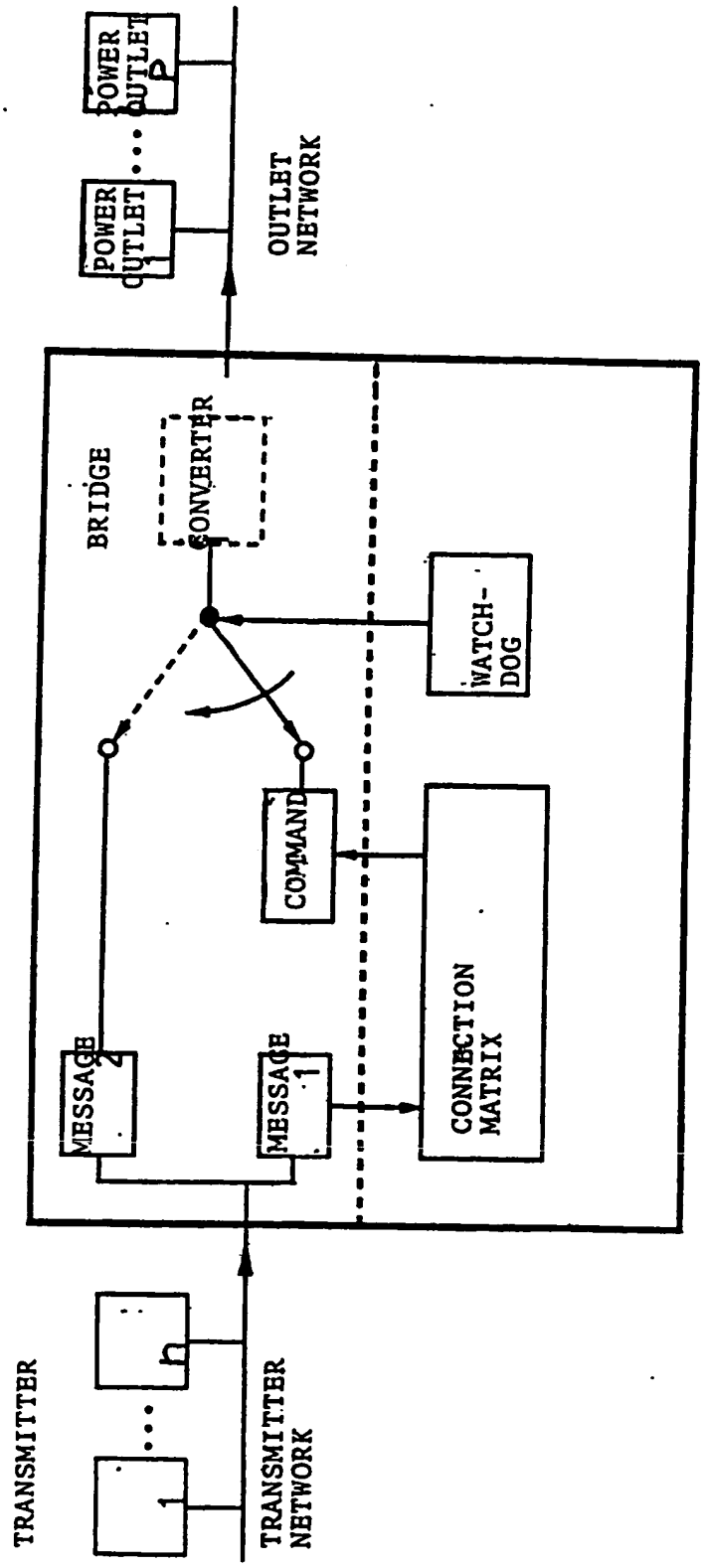
TRANSMITTER
1
n
TRANSMITTER NETWORK
CENTRAL UNIT
MESSAGE 2
MESSAGE 1
COMMAND
CONNECTION MATRIX
WATCH-DOG
BRIDGE
CONVERTER
OUTLET NETWORK
POWER OUTLET 1
POWER OUTLET p

Fig.3

INTERNATIONAL SEARCH REPORT

International Application No PCT/NO 90/00011

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: H 02 J 13/00, H 04 B 3/54, H 04 Q9/00//H 05 B 37/ 02
G 08 B 25/00

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	H 02 J, H 04 B, H 04 Q, H 05 B, G 08 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	WO, A1, 8810020 (STAREC NOMINEES PTY, LTD) 15 December 1988, see page 8, line 29 - page 13, line 27 --	1,3-5,7, 8
Y	WO, A1, 8101350 (GENERAL ELECTRIC COMPANY) 14 May 1981, see abstract; claims 1,3,5,7,19, --	1-8
Y	Wireless World, Vol. 85, December 1979 McArthur, N. et al: "The Intelligent Plug ", see page 46 - page 51 --	1,2,4,5, 8
Y	WO, A1, 8606890 (BRITISH TELECOMMUNICATIONS PUBLIC LIMITED CO) 20 November 1986, see page 3, line 6 - page 5, line 26; page 10, line 3 - page 11, line 30 --	1,2,4,5, 8

* Special categories of cited documents: [10]

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
24th April 1990	1990 -04- 27
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Bo Gustavsson

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
Y	US, A, 4418333 (R.J. SCHWARZBACH ET AL) 29 November 1983, see column 7, line 46 - column 8, line 11; column 26, line 10 - column 27, line 5; column 28, line 62 - column 29, line 26 --	1,2,4,5, 8
Y	DE, AI, 3711244 (SIEMENS AG) 20 October 1988, see the whole document --	1,3,8

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/NO 90/00011

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 90-03-30
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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		DE-A-	3039666	81-05-14
		EP-A-B-	0038852	81-11-04
		JP-A-	56082906	81-07-07
		US-A-	4367414	83-01-04
		US-A-	4396844	83-08-02
		US-A-	4484258	84-11-20
		US-A-	4489385	84-12-18
		US-A-	4511895	85-04-16
		US-A-	4535332	85-08-13
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